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FIGURE 1. Peach calico in J. H. Hale peach leaves.

PLANT PATHOLOGY ISSUE

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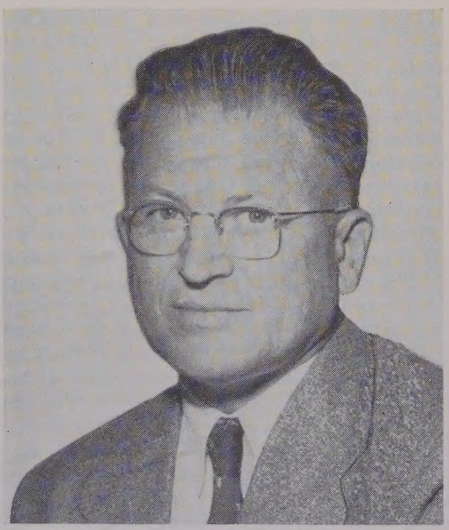
Plants Have Diseases

ALLEN B. LEMMON, *Chief, Division of Plant Industry, California Department of Agriculture*

The average annual loss from plant diseases in the United States, as estimated in the 1953 Yearbook of Agriculture, is about three billion dollars, or approximately half a billion dollars more than the total amount received by California farmers annually from the sale of their farm products. California, with its wide diversity of climate and crops, has many plant diseases which contribute to this enormous cost.

The Agricultural Code charges the Department of Agriculture with promoting and protecting the agricultural industry of the State, and provides that the department shall prevent the introduction and spread of injurious insect or animal pests, plant diseases and noxious weeds. This is the basis for the work carried on by certain bureaus in the department, including the Bureau of Plant Pathology. This bureau is one of six in the Division of Plant Industry concerned with duties relating to regulatory work for the benefit of California's agricultural crops. Its work is coordinated with that of other bureaus in the department and with that of the agricultural commissioners in the county departments of agriculture so as to best serve California's agricultural industry.



Work of the Bureau of Plant Pathology, California Department of Agriculture

GILBERT L. STOUT, *Chief, Bureau of Plant Pathology, California Department of Agriculture*

The Bureau of Plant Pathology is concerned primarily with infectious diseases of plants such as those caused by bacteria, fungi, viruses, plant parasitic nematodes and parasitic flowering plants. Its work includes prevention of the introduction and spread of new diseases, their detection when introduced, and their suppression and eradication when incipient outbreaks occur. In order to keep up to date technically for this work, the bureau keeps closely in touch with new developments in plant pathology through the various public and private research agencies, not only in California, but also throughout the United States and other countries, and endeavors to keep currently abreast of new methods and developments in plant disease prevention and suppression.

The bureau provides technical assistance and acts in an advisory capacity in matters pertaining to plant diseases for the county departments of agriculture, the Bureau of Plant Quarantine, and other bureaus in the Department of Agriculture. Coordination and leadership is provided in cooperative plant disease work with the county agricultural commissioners, and a working relationship is maintained with the counties and with the United States Department of Agriculture in survey, suppression and eradication work for specific plant diseases. Diagnostic laboratories are maintained at Sacramento and Riverside where plant disease specimen material is received from the counties, from other bureaus in the department, and from other sources. The bureau operates a cooperative Agricultural Marketing Service project, supported half by state and half by federal funds, for the development of methods and techniques for certification of nursery stock and plant propagating materials for freedom from serious virus diseases. This work is conducted under au-

thority of the Federal Agricultural Marketing Act of 1946 and complementary state legislation.

Particular attention is given to the detection and suppression of new plant diseases and to the training and assisting of county personnel for this work. In this connection the bureau prepares illustrated descriptive articles on specific plant diseases for use in a plant disease handbook for agricultural inspectors. These are published from time to time in the California Department of Agriculture *Bulletin*, and four of them are presented in this issue.

Plant pathology in what is now the California Department of Agriculture had its beginning as a permanent specific function in 1921, when D. G. Milbrath was employed as plant pathologist in what was then called the Bureau of Pest Control. Prior to that time the late H. S. Fawcett had been employed as plant pathologist by the California State Commission of Horticulture, during the period 1912 to 1913. This agency was the forerunner of the California Department of Agriculture, which was established in 1919. Between 1913 and 1921, plant pathology problems in the Commission of Horticulture and in the Department of Agriculture were handled by personnel which also had other duties. Plant Pathology was given bureau status in 1931, and D. G. Milbrath became its first chief.

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The bureau also employes seasonal personnel.

Peach Calico, One of Many Virus Diseases of Stone Fruits [1]

H. KEITH WAGNON, *Associate Plant Pathologist*
JAMES R. BREECE, *Assistant Plant Pathologist,*
Bureau of Plant Pathology, California Department of Agriculture

Peach calico, a virus disease known to occur only on peach, was first reported in 1940 in Idaho (1). In 1943 it was reported in Washington (8), and in 1952 in California (11). It has been reported only from these three states, and is not known to occur outside of the United States. Peach calico is of limited distribution, but should it become widespread in peach plantings, it could be of considerable economic importance. It may retard the growth of a tree, and render some of the fruit unmarketable.

When the disease was first found in California in 1952, it was observed in two trees (11), one of the J. H. Hale variety in Contra Costa County, and the other of the Rio Oso Gem variety in San Joaquin County. It has been observed in Sutter, Stanislaus and Tehama Counties in subsequent years (5, 6, 7, 12, 13).

Symptoms and Varietal Susceptibility

Symptoms of peach calico occur on the leaves, on the stems of current year shoots, and on the fruit (2, 4, 8). The most conspicuous symptoms are those found on the leaves (Figs. 1 [cover] and 2C), particularly on those leaves which develop during the spring and early summer. Occasionally certain shoots will produce the symptomatic leaves throughout the growing season. Usually, an affected twig will have both symptomatic as well as symptomless leaves.

The first leaf symptoms of peach calico usually appear as the leaves unfold, and consist of a mottle or mosaic pattern of green, pale green, yellow, cream, and white. As the young affected leaves age, the pale green areas change to creamy yellow, and even papery white (Fig. 1). The areas of the leaf lacking green pigmentation may follow along each side of the midrib (Fig. 2C), often forming a symmetrical pattern. However, in many instances the pattern is spectacular in its nonuniformity (Fig. 1). In extreme situations all, or the greater part, of some individual leaves may be completely devoid of green pigment. These leaves frequently become necrotic along their margins during periods of hot weather.

Creamy white streaks or blotches occur on stems of seriously affected shoots. The margins of these light areas are often pink or sometimes reddish in color. Characteristic stem symptoms usually do not develop on shoots where symptoms are scarce or lacking on the leaves.

Fruits on affected branches may begin to show symptoms when they are less than an inch in diameter. These symptoms consist of irregular patches of creamy white or bleached tissue showing through the pubescence. As the fruit matures, the affected areas may become orange or reddish. Affected fruits generally do not attain normal size, and may be more spherical than nonaffected ones.

The erratic occurrence of symptoms on different trees suggests that there may be more than one strain of peach calico virus. In Idaho and Washington, trees have been observed to show fewer and less distinctive symptoms in successive years. Observations in California have been similar for certain trees of Rio Oso Gem, Elberta, and Gaume varieties. However, the symptoms on the original J. H. Hale tree found in California in 1952 have become more pronounced each year. During the 1956 season, approximately ten percent of the fruits on this tree were affected, and were unmarketable. Perhaps the severity of the disease is influenced by pruning. Two S-37 seedling peach trees which received buds from a calico-infected peach tree of unknown variety have shown severe stem and leaf symptoms on shoots which were forced to grow from the seedlings at

[1] Part of the observations reported in this paper were made during work done under Agricultural Marketing Service Project Number RM: C-3550-27, for which state funds were matched with federal funds received from the Agricultural Marketing Service, United States Department of Agriculture, under provisions of the Agricultural Marketing Act of 1946.

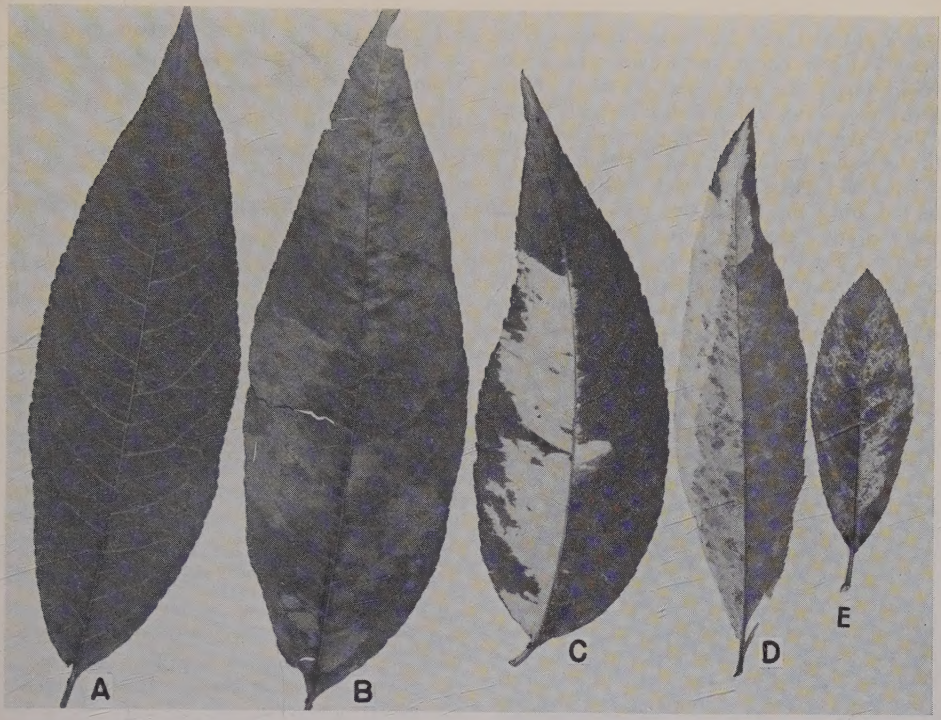

FIGURE 2. Peach leaves showing: A—No symptoms (normal). B—Peach blotch. The mosaic pattern is made up of light and dark shades of green. C—Peach calico. The striking mosaic pattern is made up of creamy white and green areas. D—Peach variegation. Note the three sharply delimited areas of different colors on this leaf. E—Early spring symptoms of almond calico in peach. Note the stippled character of the mosaic pattern. The light-colored areas on this leaf are yellowish orange. (Photograph by C. Clower.)

points adjacent to or below the position where the buds had been placed. The J. H. Hale tree, as well as the S-37 seedlings, have been rather heavily pruned.

Peach calico has been reported on the Rochester, Early Crawford, and Elberta peach varieties and on peach seedlings in Idaho and Washington. In California, symptoms have been observed on the J. H. Hale, Rio Oso Gem, Elberta, and Gaume peach varieties; on S-37 peach seedlings; and on the Early Le Grande variety of nectarine. It is suspected that all peach and nectarine varieties are susceptible. Attempts to infect cherry, apricot, and Italian prune have been negative (3).

Comparison With Other Diseases

Because of similarity in leaf symptoms, peach calico may be confused with peach variegation (4), believed to be of genetic origin, and with two virus diseases in peach, one known as peach blotch (14) and the other as almond calico (9, 10). Sometimes it is difficult to distinguish between these disorders and to make a positive diagnosis, because of the great variation and overlapping of leaf symptoms. This may be especially true when only a limited number of leaves with symptoms are available. Several peach trees have been observed in California with symptoms suggestive of both peach calico and peach blotch. All of these disorders occur in California (10, 13), may be disseminated through the use of budwood from affected trees, and may exhibit symptoms in nursery stock as well as in commercial plantings.

Peach blotch may be distinguished from peach calico by the absence of fruit and twig symptoms and, particularly, in mature leaves, by well defined pale green to yellow-green areas (Fig. 2B) as compared to creamy white to white areas in some peach calico

leaves (Figs. 1 and 2C). Also, symptoms of peach blotch occur on leaves which develop during the early and late parts of the growing season, whereas leaves with peach calico symptoms may appear throughout the growing season.

Almond calico on peach has been observed only on the leaves which develop early in the growing season. The affected leaves are characterized by yellow-orange blotches which often hav a stippled appearance (Fig. 2E). There have been no twig or fruit symptoms reported for this virus disease.

Peach variegation, a nontransmissible condition, is perhaps the one disorder which is most frequently confused with peach calico. Variegation usually can be distinguished by the rather sharply delimited areas with at least three distinct shades of green (Fig 2D). However, creamy white to white areas may also be present on some leaves. In extreme cases, all or half of the lamina of some leaves may lack green pigment. Commonly the symptomatic leaves of variegation will be present on only a single shoot, the stem of which sometimes may exhibit a yellow coloration. Fruit symptoms which resemble those of peach calico are found on rare occasions.

Methods of Spread and Control

Natural spread has not been demonstrated, and if it occurs, it apparently is very slow. However the virus which causes the disease can be carried in propagating material such as budwood and scions, and can be carried into new areas by means of infected nursery stock. It is not known whether the virus can be transmitted through the seed from infected trees. Very few stone fruit viruses have been shown to be seed transmitted.

Control of the disease consists primarily in avoiding the use of propagating material from infected trees.

Literature Cited

1. Blodgett, E. C., 1940. Fruit Diseases in Idaho, 1939. U. S. Dept. Agric., Plant Dis. Rptr. 24:177-182.
2. Blodgett, E. C., 1944. Peach Calico. Phytopath. 34:650-657.
3. Blodgett, E. C., 1951. Peach Variegation. *In* Virus Diseases and Other Disorders with Viruslike Symptoms of Stone Fruits in North America. U. S. Dept. Agric., Agric. Handbook 10, pp. 213-214.
4. Blodgett, E. C., and E. L. Reeves, 1951. Peach Calico. *In* Virus Diseases and Other Disorders with Viruslike Symptoms of Stone Fruits in North America. U. S. Dept. Agric., Agric. Handbook 10, pp. 90-92.
5. Hiltabrand, Wray, 1953. Nursery Service. Thirty-fourth Ann. Rep., Calif. Dept. Agric. Bul. 42:246-252.
6. Mesenger, A. P., 1954. Nursery Service. Thirty-fifth Ann. Rep., Calif. Dep. Agric. Bul. 43: 204-208.
7. Messenger, A. P., and E. A. Breech, 1956. Nursery Service. Thirty-sixth Ann. Rep., Calif. Dept. Agric. Bul. 45:194-198.
8. Reeves, E. L., 1943. Virus Diseases of Fruit Trees in Washington. Wash. State Dept. Agric. Bul. 1, 25 pp.
9. Thomas, H. E., and T. E. Rawlins, 1939. Some Mosaic Diseases of *Prunus* Species. Hilgardia 12:623-644.
10. Thomas, H. E., and T. E. Rawlins, 1951. Almond Calico. *In* Virus Diseases and Other Disorders with Viruslike Symptoms of Stone Fruits in North America. U. S. Dept. Agric., Agric. Handbook 10, pp. 189-190.
11. Wagnon, H. K., 1952. Virus-free Nursery Stock. Thirty-third Ann. Rep., Calif. Dept. Agric. Bul. 41:280-282.
12. Wagnon, H. K., 1954. Virus-free Nursery Stock. Thirty-fifth Ann. Rep., Calif. Dept. Agric. Bul. 43:220-223.
13. Wagnon, H. K., 1956. Virus-free Nursery Stock. Thirty-sixth Ann. Rep., Calif. Dept. Agric. Bul. 44:183-185.
14. Willison, R. S., 1951. Peach Blotch. *In* Virus Diseases and Other Disorders with Viruslike Symptoms of Stone Fruits in North America. U. S. Dept. Agric., Agric. Handbook 10, pp. 93-94.

Citrus Canker—A Bacterial Disease Caused by Xanthomonas citri[1]

By E. C. CALAVAN, *Associate Plant Pathologist, Department of Plant Pathology, University of California, Citrus Experiment Station, Riverside, California*

Citrus canker, caused by *Xanthomonas citri* (Hasse) Dowson, is in many countries the most destructive bacterial disease of citrus. Canker has never been reported in Arizona or California and supposedly has been eradicated from other citrus areas in the United States of America. Therefore, relatively few plant pathologists in this country ever have seen citrus canker lesions.

Symptoms

On young leaves, canker bacteria form small, slightly yellowish spots about 1 mm. in diameter. These spots are usually visible at first on the lower surfaces, for except through injuries, the organism commonly enters the host through the stomata. Later stages usually show small white to pale yellow spongy eruptions, sometimes darkening to tan or brown. The margin of the roughened area generally has a glazed and greasy appearance. After several weeks a lesion may be 3 to 4 mm. in diameter and brown and roughened on both leaf surfaces. At all stages, leaf lesions commonly have a watery, yellowish halo which shades into the normal green of the leaf. Young lesions are often round, or nearly so, but as they age they tend to become irregular, hard, and corky. Lesion size is variable. Figure 1 shows citrus canker lesions on grapefruit leaves.

FIGURE 1. Citrus canker (*Xanthomonas citri* [Hasse] Dowson) on grapefruit leaves. (Photograph courtesy of the Florida State Plant Board.)

Lesions on fruits (Figs. 2 and 3) resemble those on the leaves. Rough spongy eruptions involve the surface layers and some deeper rind tissues but the infection does not extend into the vesicles. Usually the glazed oily appearing margin is present, and the yellow halo absent. A crater-like appearance develops in some fruit lesions. Cankers on grapefruit, pummelos, and some sweet oranges are large, elevated at first, but later often somewhat sunken. Those on limes and lemons are smaller and decidedly raised; rarely become depressed. Satsuma orange fruits are readily infected at certain stages but the lesions usually remain small and may be mistaken for scab. However, a few Satsuma fruit lesions attain diameters over 3 mm. (Fig. 3).

Twig lesions (Fig. 4), common on the more susceptible hosts but rare on the more resistant, resemble those on the foliage. Cankers on branches up to three inches in diameter are common in the most susceptible trees.

[1] A general paper prepared largely from information published by many workers. Readers interested in added detail, literature references and illustrations are referred to H. S. Fawcett, Citrus Diseases and Their Control. McGraw-Hill, New York. 1936.

FIGURE 2. Citrus canker (*Xanthomonas citri* [Hasse] Dowson) on grapefruit. (Photograph courtesy of the Florida State Plant Board.)

Host Range and Varietal Susceptibility

The host range of *Xanthomonas citri* includes the various species of the genus *Citrus*, citrus hybrids, and many citrus relatives in the family Rutaceae. One or more species in each of the following rutaceous genera is considered to be a host: *Aegle*, *Atalantia*, *Casimiroa*, *Chaetospermum*, *Citropsis*, *Clausena*, *Eremocitrus*, *Evodia*, *Feronia*, *Feroniella*, *Fortunella*, *Hesperethusa*, *Melicope*, *Microcitrus*, *Murraya*, *Paramignya*, *Poncirus*, *Toddalia*, and *Xanthoxylum*. Some of the unlisted rutaceous genera native to North America probably are susceptible to citrus canker. One nonrutaceous host, *Lansium domesticum*, has been reported.

Citrus species, hybrids, and relatives differ greatly in their susceptibilities to citrus canker. *Poncirus trifoliata* and its hybrids generally are highly susceptible. Under Florida conditions the general order of decreasing susceptibility was grapefruit, trifoliate orange, lime, sweet orange, and lemon. Substantial varietal differences within a species were reported. However, the following descending order of susceptibility was reported from New Zealand: Ponderosa, Eureka and Meyer lemons; Marsh grapefruit; Washington Navel, Valencia and other sweet oranges; and Poorman orange. Some lime plantings on Mauritius were practically wiped out by citrus canker.

Calamondins and most kumquats are highly resistant. Satsuma oranges develop canker lesions (Fig. 3) but are sufficiently resistant, as are East Indian pummelos, to be grown commercially in canker areas. Canker on such fruits may often escape notice.

Causal Organism

The bacterium, *Xanthomonas citri* (Hasse) Dowson, was determined to be the cause of citrus canker by Clara H. Hasse, who in 1915 described it as *Pseudomonas citri*, n. sp. It is a gram negative rod usually 1.5 to 2 microns by 0.5 to 0.75 microns with rounded ends and a polar flagellum. Chains and larger forms occur. The organism may be isolated from canker lesions by thoroughly macerating diseased tissue in about 10 ml. of sterile tap water and streaking the mixture or dilutions from it on peptone-beef, nutrient, or potato-dextrose agar plates. At room temperature within 36 to 48 hours single colonies may appear as barely visible glistening points. Within three to four days the colonies are a dull yellow color, round, glistening, and smooth.

Diagnosis

On agar cultures yellow colonies of saprophytic bacteria frequently appear. A ready test for *X. citri* in culture is the characteristic growth on potato cylinders; at first empire yellow, then wax yellow or primuline yellow. A white halo around the colony appears after two to four days. The only completely reliable diagnostic procedure is the reproduction of canker lesions (within five days to two weeks) following inoculation of young, recently expanded, grapefruit leaves. For best results use macerated canker tissue or a bacterial suspension from a culture, and swab the suspension on the lower surfaces of leaves. Then incubate the plants at temperatures of 75° to 85° F. and very high relative humidity. Numerous puncture wounds on the lower surfaces of the leaves favor infection. Young lesions, from inoculations, generally have a watery, halo-like appearance and under favorable conditions develop a white spongy eruption. Halos persist in older lesions and lesion margins may become somewhat glazed and yellowed.

FIGURE 3. Upper—Old citrus canker lesions on mature fruits of Unshu (Satsuma) orange. Lower—Exceptionally large canker lesions on mature Unshu fruit, enlarged 5.3 diameters. Preserved material from Japan photographed by K. L. Middleham.

Survival

X. citri survives principally in lesions on living twigs, leaves, and fruits during periods unfavorable to infection. It may persist also for a time in fallen or dead host material or in the soil itself. *X. citri* can survive about 4 months under ordinary laboratory conditions but is killed by about 2 minutes exposure to direct sunlight. In some soils the bacteria survive for months, or possibly for years according to one report, but usually they quickly die in the soil. Some of the bacteria remain alive for months in lesions on fruit. *X. citri* is quickly killed by direct contact with certain bactericides but complete eradication within fruit lesions by chemicals harmless to the fruit and to consumers has not been achieved.

History and Geographical Distribution

Citrus canker probably originated in southeast Asia or nearby islands. Herbarium specimens collected in northwest India about 1830 and in Java about 1842 show lesions which appear to be those of citrus canker. Canker is known to have been present in Japan in 1899 and may have been taken there on citrus fruits or propagative material from China. Canker was carried from Japan on shipments of trifoliate orange seedling trees to Texas, Mississippi, Alabama, Florida, and South Africa. In South Africa and in the Gulf states the disease caused very extensive damage.

Citrus canker also was introduced into Australia, Mozambique, New Zealand, and the Fiji Islands. Eradication measures were adopted by these countries. The disease has been reported from Assam, Belgian Congo, Ceylon, China, Formosa, Hawaiian Islands, Hong Kong, India, Indo-China, Indonesia, Iraq (?), Japan, Liu-kiu Islands, Madagascar (?), Malaya, Mauritius, New Guinea, Philippines, Seychelles, and Thailand. In Argentina, Paraguay, and Uruguay a similar, but different, disease called false canker or Cancrosis B is prevalent.

Eradication

The success of the eradication programs, inaugurated after citrus canker was well established, in the United States and in South Africa is one of the outstanding accomplishments of plant-disease control.

Soon after citrus canker was determined to be a new and serious disease in Florida in July 1913, eradication attempts were begun. By September 1914, canker had been recognized in Alabama, Mississippi, Louisiana, and Texas, and had been called by far the worst disease ever to affect the citrus industry. The Florida Growers' and Shippers' League was instrumental in arousing the interest of growers toward fighting canker. The State Plant Board of Florida was formed and assumed a leading role in the canker-eradication program in that state. Other Gulf states also undertook organization for canker eradication. The Federal Government became interested and from 1915 to 1933 maintained cooperative canker-eradication activities with Florida, Alabama, Louisiana, Mississippi, and Texas.

Eradication efforts were so successful that in 1923 only 11 canker-infected trees were

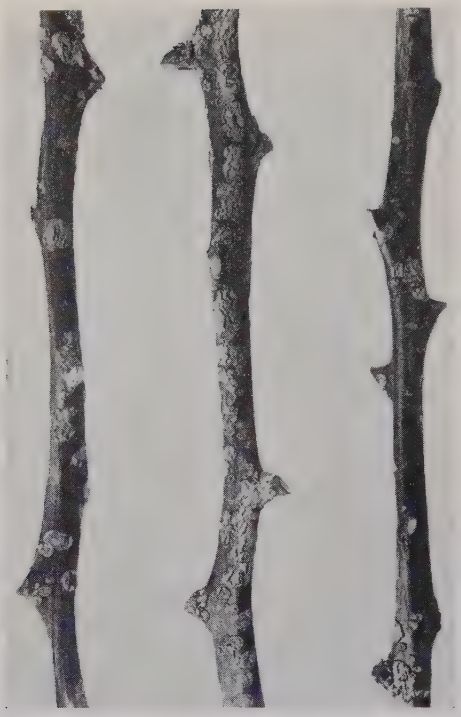

FIGURE 4. Citrus canker (*Xanthomonas citri* [Hasse] Dowson) on trifoliate-orange twigs. (Photograph courtesy of the Florida State Plant Board.)

found in Florida. By 1927 canker appeared to be eradicated in that state. In 1935, scouting operations failed to disclose any infection in the commercial citrus areas of the lower Rio Grande Valley of Texas or in the citrus growing areas of Mississippi and Alabama. During 1935-36, more than 1,500,000 canker-infected or exposed citrus and other trees were located and destroyed in noncommercial citrus areas of Louisiana and Texas.

In 1940, only one infected property was found in Louisiana, and one in Texas. In 1945 the United States Department of Agriculture reported that no trace of citrus canker could be found in Texas and that Federal participation had been withdrawn. In 1947-49 a thorough resurvey of Texas citrus areas revealed no canker. No citrus canker has been reported recently in the United States. In South Africa, where canker was less severe than in the Gulf states, the canker-eradication program was by 1938 considered successful.

Citrus canker eradication in seven southern states cost about $5,000,000 in federal, state, and private funds. In addition to this expense about 1,110,000 grove trees, 1,500,000 abandoned or wild trees, and 6,580,000 nursery trees were destroyed. The writer estimates that the total damage from citrus canker in the Gulf states, counting lost production, trees, eradication, and losses due to quarantine restrictions, exceeded $40,000,000.

Control

Fungicides such as Bordeaux mixture have been used to reduce the amount of canker infection in some Asiatic countries but have not proved to be effective for eradication. Quarantines against fresh fruits and plant parts of citrus and citrus relatives from areas known to have citrus canker have been established by many countries. Examples are U.S.D.A. quarantine Nos. 19, 28, and 75. Accidental and illegal introductions may occur. Citrus canker frequently is intercepted on fruits brought from the Orient. Continued vigilance in ports of entry, markets, and groves therefore is essential to prevent the introduction of the citrus canker organism into canker-free areas and to detect its appearance or recurrence before it becomes widely established.

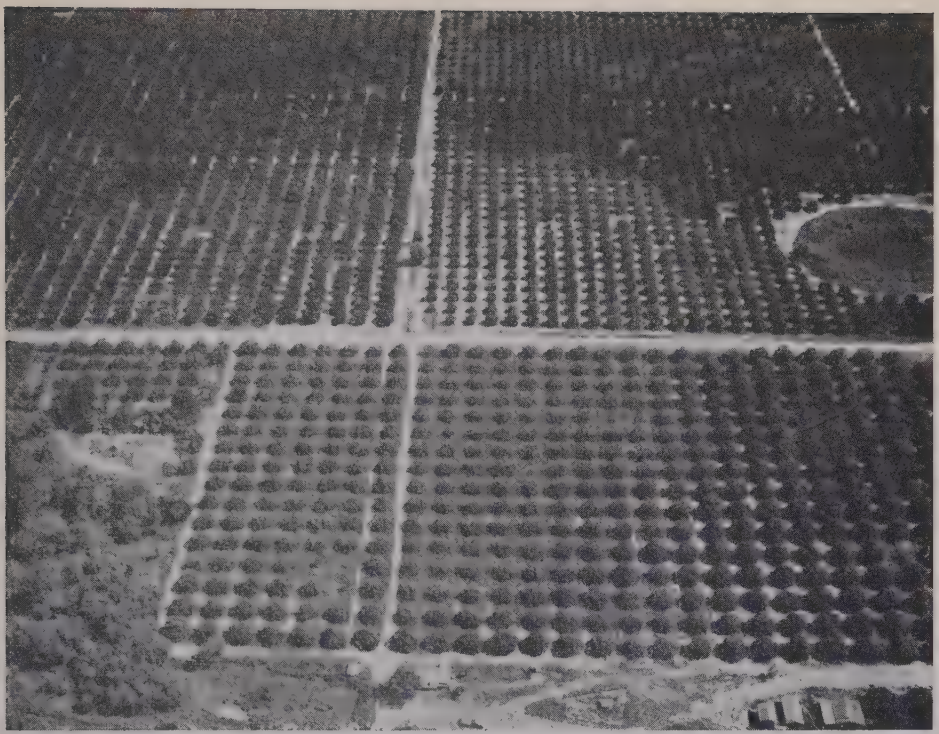

FIGURE 1. Aerial view of spreading decline area in a Florida citrus grove. Note large area of lighter colored trees. (Photograph courtesy of the Florida State Plant Board.)

Spreading Decline of Citrus Caused by the Burrowing Nematode

By W. H. HART, *Associate Plant Pathologist (Nematology), Bureau of Plant Pathology, California Department of Agriculture*

The disease known in Florida as spreading decline, caused by the burrowing nematode, *Radopholus similis*, has been reported to be the most serious condition affecting Florida citrus (10, 16). The term spreading decline refers to a disease characterized by constantly enlarging areas of weakened, unthrifty trees. It has been estimated (15) that over 6,000 acres of commercial citrus are infested with the burrowing nematode in Florida. According to the same author, this nematode, which is known to infect many different kinds of plants, has been found in 32 Florida counties, and is causing spreading decline of citrus in 16 counties, particularly in the sandy soil of the central citrus area. It has been found in 888 of 4,071 groves surveyed and in 284 of 2,131 nurseries.

The spreading decline disease is not known to be present in California, and in view of the State's large citrus acreage (approximately 245,000 acres), it is one of the diseases for which plant disease survey and detection personnel should be alert.

Symptoms

Spreading decline of citrus is characterized above ground by areas of declining trees rather than by specific symptoms in indi-

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vidual trees (Figure 1). Infected trees exhibit nonspecific top symptoms, such as stunting, sparse foliage, undersized leaves, reduced terminal growth, and lowered yields. These symptoms also can result from girdling or root damage resulting from a number of other causes such as gopher injury, water-logged soil, or quick decline (tristeza) virus. Trees affected with spreading decline are not necessarily killed by the disease but are weakened and give subnormal yields. Such trees wilt more readily than normal trees (17).

The affected area in a spreading decline grove gradually enlarges more or less evenly in all directions. The rate of enlargement varies somewhat between groves and from year to year, and varies with the slope and the flow of underground waters (11). The annual rate of spread in 25 groves in Florida over a period of five years averaged 1.6 trees per year. The nematodes have crossed under roadways and through uncultivated strips up to 100 feet wide, apparently along lateral roots (10, 15).

Trees in spreading decline areas have extensive deterioration of feeder roots below a depth of 18 to 20 inches. Affected rootlets develop brownish lesions or cavities which enlarge and become more numerous as the nematode population increases. Feeder roots are girdled, blinded, and destroyed by the nematodes, allowing entry of secondary decay organisms. Affected trees have about 40 percent less total feeder roots than normal trees and, at depths below 30 inches, 90 percent of the feeder roots may be destroyed (10).

Host Range

The known hosts of the burrowing nematode include plants in a broad range of plant families. Plants with succulent roots are preferred, but the nematode attacks the fine rootlets of many plants. Citrus and avocado are among the host plants most severely injured. All varieties of citrus rootstocks tested appear to be susceptible. In avocado, as in citrus, the nematode causes a destruction of feeder roots resulting in unthrifty and declining trees (9, 22).

Ornamental hosts are of importance primarily as a means of disseminating the nematode. In Florida, observations indicate that spreading decline areas often have begun in the vicinity of homesites in or near citrus groves (10, 13), suggesting that infected ornamentals were the source of the infestation.

The recorded hosts of the burrowing nematode, based on available literature (4, 5, 6, 8, 12, 14), are shown in the accompanying list.

HOST PLANTS REPORTED FOR THE BURROWING NEMATODE

Radopholus similis

Family	*Scientific name*	*Common name*
Acanthaceae	*Acanthus montanus* T. Anders	Acanthus
	[1]*Beloperone guttata* Brandegee	Shrimp plant
	Jacobinea sp.	Jacobinea, Cardinal Guard
	Ruellia makoyana Hort.	Ruellia
Amaranchaceae	*Celosia nitida* L.	Wild Celosia
Apocyanaceae	*Allamanda cathartica* var. *williamsii* Raffil.	Allamanda
	A. neriifolia Hook.	Allamanda
	Vinca rosea L.	Periwinkle
Araceae	*Anthurium* spp.	Anthurium, Flamingo flower
	Philodendron spp.	Philodendron
	Scindapsus aureus Engler.	Pothos
Bignoniaceae	*Jacaranda* sp.	Jacaranda
	Pyrostegia ignea Presl.	Flame vine
Bromeliaceae	*Ananas comosus* Merr.	Pineapple
Buxaceae	*Buxus microphylla* var. *japonica* Rehd. and Wils.	Japanese boxwood
Cannaceae	*Canna edulis* L.	Edible canna
Commelinaceae	*Commelina* spp.	Commelina, Day flower
Convolvulaceae	*Ipomea batatas* Poir.	Sweet potato
Cyperaceae	[2]*Cyperus papyrus* L.	Paper plant
	Cyperus rotundus L.	Nut grass
Ebenaceae	*Diospyros kaki* L.	Japanese persimmon
	D. virginiana L.	Common persimmon
Euphorbiaceae	*Breynia nivosa* Small	Snowbush
	Ricinus communis L.	Castor bean
Graminae	[1]*Digitaria sanguenalis* (L.) Scop.	Crabgrass
	Giganthochloa apus Kurz.	Bamboo
	Panicum hemitomon Schult.	Maiden cane grass
	P. maximum Jacq.	Guinea grass
	Rhynchelytrum roseum (Nees) Stapf and Hubb.	Natal grass
	Saccharum officinarum L.	Sugarcane
	Schizostachyum sp.	Bamboo
Illiciaceae	[1]*Illicium anisatum* L.	Anise
Lauraceae	[1]*Cinnamomum camphora* (L.) Nees and Eberm.	Camphor tree
	Persea americana Mill.	Avocado

Family	Scientific name	Common name
Leguminosae	[1]*Albizzia lebbek* Benth.	Woman's tongue tree
	Bradburya pubescens Benth.	Butterfly pea
	Bradburya sp.	
	Cajanus cajan Millsp.	Pigeon pea
	Calopogonium mucunoides Desv.	
	[1]*Delonix regia* Raf.	Royal Poinciana
	Desmodium tortuosum DC.	Beggar weed, Meibomia
	Indigofera endecaphylla Jacq.	Indigo
	I. hirsuta L.	Hairy indigo
	Tephrosia candida DC.	
	Vigna hosei Backer.	Cow pea
Magnoliaceae	[1]*Magnolia grandiflora* L.	Magnolia
Malpighiaceae	*Malpighia glabra* L.	Barbados-Cherry
Malvaceae	*Hibiscus rosa-sinensis* L.	Hibiscus
	Urena lobata L.	Caesar's weed, French cocklebur
Marantaceae	*Calathea lietzei* Morr.	Calathea
	C. ornata Koern.	Calathea
	[1]*Maranta leuconeura* var. *kerchoveana* Morr.	Maranta
Menispermaceae	*Cocculus* sp.	Cocculus
Musaceae	*Heliconia* sp.	Heliconia
	Musa spp.	Banana
	Strelitzia reginae Banks.	Bird-of-paradise
Myrtaceae	[1]*Eugenia* sp.	Australian brush cherry
	[1]*Feijoa selloviana* Berg.	Feijoa
	Psidium cattleianum Sabine.	Cattley Guava
	P. guajava L.	Guava
Oleaceae	*Jasminium* spp.	Jasmine
Palmaceae	[1]*Collinia elegans* Liebm.	Chamaedorea palm, parlor palm
	Phoenix canariensis Chaband.	Canary Island date palm
Pandanaceae	*Pandanus veitchii* Dall.	Pandanus
Phytolaccaceae	*Rivina humilis* L.	Bloodberry
Piperaceae	*Peperomia obtusifolia* A. Dietr.	Peperomia
	Piper cubeba L.	Cubeb
	P. nigrum L.	Black pepper
Podocarpaceae	*Podocarpus macrophylla* D. Don. var. *maki* Endl.	Podocarpus
Rosaceae	*Eriobotrya japonica* Lindl.	Loquat
Rubiaceae	*Coffea* spp.	Coffee
	[1]*Gardenia jasminoides* Ellis.	Cape jasmine
	Ixora coccinea L.	Ixora
Rutaceae	*Citrus* spp.	Citrus
Sapotaceae	*Chrysophyllum cainito* L.	Star apple
Smilacaceae	*Smilax lanceolata* L.	Jacksonbrier
Solanaceae	*Capsicum frutescens* L.	Bird pepper
	Cestrum nocturnum L.	Night Jessamine
	Solanum nigrum L.	Black nightshade
	Solanum seaforthianum Andr.	Brazilian nightshade
Theaceae	*Thea sinensis* L.	Tea
Urticaceae	*Pilea involucrata* Urban.	Aluminum plant
Verbenaceae	*Callicarpa americana* L.	French mulberry
Zingiberaceae	*Alpinia speciosa* Schum.	Shell lily
	Hedychium coronarium Koenig.	Ginger lily, Garland flower
	Zingiber sp.	Ginger

[1] Listed as suspected hosts by Florida workers but not yet confirmed.
[2] On one plant in Orange County; plant originated in the Hawaiian Islands.

The Causal Organism

The burrowing nematode and others of the genus *Radopholus* are closely related to, and bear a strong resemblance to, the root lesion or meadow nematodes, *Pratylenchus* spp. Both sexes retain a worm-like body throughout life, and do not become swollen or cyst-like as do the adults of certain other nematodes. Adults of the burrowing nematode average about 0.65-0.70 mm. in length with the female being robust and possessing a strong spear and rounded lip region. Males are more slender than the females and have a slender spear and subspheroid lip region. Tails of both sexes are elongate-conoid and have a rounded or often irregular terminus.

The burrowing nematode enters the rootlets and feeds on and destroys the cells of the cortex tissue. Eggs are deposited within the rootlets and the young continue to feed and develop endoparasitically. Brownish to blackish lesions are formed which girdle and destroy the rootlets. As the latter deteriorate, larvae and adults move out into the surrounding soil in search of new host tissue, and infection is spread to other roots of the same plant or to adjacent plants.

Studies have shown that the burrowing nematode prefers soil temperatures below about 78 degrees F., and is usually not found in the surface soil layers of citrus groves where soil temperatures are high (10, 15). It may be found in or near the surface layers in cool moist heavily shaded soil under certain dense types of plants.

The burrowing nematode was first described by Cobb in 1893 under the name *Tylenchus similis* (7). It has been variously described since that time as *Tylenchus acutocaudatus* Zimmerman, 1898; *T. biformis* Cobb, 1906; *Anguillulina similis* Goodey, 1932; and *Rotylenchus similis* Filipjev, 1936.

In 1949 Gerald Thorne (20) erected the genus *Radopholus* to receive the two-ovaried species resembling, in other respects, the genus *Pratylenchus*. One other species, *Radopholus oryzae* (v. Breda de Haan, 1902), was included by Thorne. Since that time two species have been added to the genus, *R. gigas* Andrassy, 1954, and *R. gracilis* (de Man) Hirschman, 1955.

Geographical Distribution

The burrowing nematode appears to be indigenous to the tropical and subtropical regions of the world. It was first reported by N. A. Cobb (7) on the roots of banana in the Fiji Islands and subsequently was reported from Jamaica, the Philippines, Formosa, Java, South India, the Dutch East Indies, the Hawaiian Islands, Brazil, and Florida (12, 15). It has been found in ornamental nursery stock arriving in California from the Hawaiian Islands, Florida, and Puerto Rico. A limited number of shipments originating in Louisiana, Texas, Mexico, Guatemala, Germany, and Denmark were not found to be infected.

History of the Disease in Florida

Spreading decline was first noticed in Florida about 1926 and was known only in a single grove near Winter Haven in Polk County (15). About 1935 the condition became apparent in a number of other groves in the same county. Many lines of investigation were explored, including nutrition, fungi, bacteria, viruses, and toxic soil substances. Studies with plant-parasitic nematodes were begun in 1946. Total nematode populations were observed to be greater in spreading decline areas than in healthy areas of the same grove, particularly below depths of about 20 inches. It was also observed that root destruction was most extensive below the 20-inch depth, suggesting that one of the nematodes present might be the causal factor. This led to the discovery in 1953 by Suit and Du Charme (17) that the burrowing nematode, *Radopholus similis* (Cobb) Thorne, is the primary cause of spreading decline.

Early in 1954 certain citrus nursery stock in Florida was found to be infected with the nematode, thus providing a means for infesting or reinfesting commercial acreages with spreading decline (13). Shortly thereafter certain types of ornamental plants were found to be infected and to be a means for dissemination of the nematode from nursery plantings to commercial citrus groves (13, 15).

Control

The State of Florida, together with the United States Department of Agriculture, has undertaken an extensive survey and control program. Root samples are taken in all nurseries and in all citrus areas and are processed by the root incubation technique developed by Young (21). Detailed maps are made of infested properties showing the extent of infested areas. The areas actually infested are usually found to extend at least two rows of apparently healthy trees beyond the margins of the visibly affected zones.

The pull and treat program being carried on by the Florida State Plant Board for control in citrus plantings consists of pulling all trees in the visibly affected area, plus at least four rows beyond the area; plowing and raking to remove roots; soil fumigation with DD (dichloropropene-dichloropropane mixture) at 600 pounds per acre (60 gallons, injected at a depth of at least 12 inches); and a fallow period of two years before replanting (1, 2, 18, 19). Nearly two million dollars have been appropriated for the control program, in which the State of Florida and the Federal Government are cooperating.

Nursery stock in Florida must be certified by inspection as apparently free of the nematode, or, if found infected or exposed to infection, must be subjected to a treatment approved by the State Plant Board. Hot water treatment of citrus nursery stock at 122 degrees F. for 10 minutes has been found to eradicate the burrowing nematode without injury to the trees (3). Investigation into possible treatment of other types of nursery stock by hot water or chemical treatment is in progress.

Survey in California

The burrowing nematode was found in California on September 21, 1954, by Dr. S. A. Sher of the University of California at Riverside on the roots of a dwarf banana plant growing in a container in a Southern California nursery. The rhizome from which this plant was grown had been imported from the Hawaiian Islands.

Records of the State Bureau of Plant Pathology and the University of California up to that time indicated that the burrowing nematode had not been found in the State in samples collected from citrus groves for examination for the citrus nematode and other plant parasitic nematodes. Few records were available concerning nematodes pres-

ent on imported plants or plants produced from imported planting stocks.

A survey was immediately initiated to determine whether the nematode was present in other imported ornamental foliage plants already in California nurseries and in planting stock and plants coming into the State. Specimens were collected by county agricultural commissioners, port inspectors, and nursery inspectors. During the period of September 21, 1954, to September 24, 1956, there were examined 2,111 root and soil samples from ornamental foliage plants and other nursery stock. Two hundred twenty samples were found infected. Infection was found most commonly in philodendron, anthurium, and Musa (banana), but was also present in pothos, strelitzia, heliconia, cyperus (papyrus), and in zingiber (ginger) species. The nematode was not found in established ornamentals grown from imported planting stock, nor was it found in a limited inspection of citrus and avocado nurseries and groves.

A cooperative reconnaissance survey of commercial citrus groves and citrus nurseries was carried out in California in 1956 by the United States Department of Agriculture, the California Department of Agriculture, and the county agricultural commissioners. Collections were also made from avocado groves and nurseries, from ornamental nurseries, and from a few other crops. A special laboratory staffed by federal personnel was set up and operated at Anaheim through the cooperation of the Orange County Agricultural Commissioner, who supplied the laboratory space and made other important contributions. Samples collected in citrus and avocado groves were selected both on the basis of areas of distressed trees and on the basis of proximity to homesites where ornamental host plants occurred. There were 4,253 samples collected from the major citrus-producing counties during the survey, representing 14,622 acres and 630 properties in 14 counties. The burrowing nematode was not found in any of the samples collected.[3]

Literature Cited

1. Anon, 1955. Work started on eradication of spreading decline. Citrus Industry 36 (9): 18.
2. Anon, 1956. Court upholds pull and treat spreading decline program. Citrus Industry 37 (8): 5.
3. Birchfield, Wray, 1955. The hot water treatment of nematode infested nursery stock. Citrus Industry 36 (3): 10-12.
4. Birchfield, Wray, 1956. New and suspected host plants of the burrowing nematode. *Radopholus similis* (Cobb) Thorne. U. S. Dept. Agric., Pl. Dis. Reptr. 40 (10): 866-868.
5. Brooks, Troy L., 1954. Host range of the burrowing nematode internationally and in Florida. Citrus Industry 35 (12): 7-8, 14.
6. Brooks, Troy L., 1955. Additional hosts of the burrowing nematode in Florida. U. S. Dept. Agric., Pl. Dis. Reptr. 39 (4): 309.
7. Cobb, N. A., 1893. Nematodes, mostly Australian and Fijian. MacLeay Mem. Vol., Linnean Soc. New South Wales: 252-308.
8. Crossman, Louise, and J. R. Christie, 1937. A list of plants attacked by miscellaneous plant infesting nematodes. U. S. Dept. Agric., Pl. Dis. Reptr. 21 (9): 156-157.
9. Du Charme, E. P., and R. F. Suit, 1953. Nematodes associated with avocado roots in spreading decline areas. U. S. Dept. Agric., Pl. Dis. Reptr. 37 (8): 427-428.
10. Du Charme, E. P., 1954. Cause and nature of spreading decline of citrus. Citrus Industry 35 (11): 6-7; 35 (12): 5-7.
11. Du Charme, E. P., 1956. Sub-soil drainage as a factor in the spread of the burrowing nematode. Citrus Industry 37 (2): 20-21.
12. Filipjev, I. N., and J. H. Schuurmans Stekhoven, 1941. A manual of agricultural helminthology. E. J. Brill, Leiden.
13. Frierson, Paul E., 1955. A progress report on the burrowing nematode work in Florida. Citrus Industry 36 (12): 5-7, 16.
14. Sher, S. A., 1954. Observations on plant parasitic nematodes in Hawaii. U. S. Dept. Agric., Pl. Dis. Reptr., 38 (9): 687-689.
15. Simanton, W. A., 1956. How has spreading decline of citrus spread? Res. Rep., Fla. Agr. Exp. Sta., 1 (3): 6-7.
16. Suit, R. F., and H. W. Ford, 1950. Present status of spreading decline. Proc. Fla. State Hort. Soc. 63: 36-42.
17. Suit, R. F., and E. P. Du Charme, 1953. The burrowing nematode and other parasitic nematodes in relation to spreading decline of citrus. U. S. Dept. Agric., Pl. Dis. Reptr. 37 (7): 379-383.
18. Suit, R. F., 1955. The experimental basis and limitations of the pull and treat method of handling spreading decline. Citrus Industry 36 (1): 12, 14-16.
19. Suit, R. F., E. P. Du Charme, and Troy L. Brooks, 1956. Effectiveness of the pull and treat method for controlling the burrowing nematode on citrus. Citrus Industry 37 (2): 9-10, 23.
20. Thorne, G., 1949. On the classification of the Tylenchida, new order (Nematoda, Phasmidia). Proc. Helm. Soc. Wash. 16 (2): 37-73.
21. Young, T. W., 1954. An incubation method for collecting migratory endoparasitic nematodes. U. S. Dept. Agric., Pl. Dis. Reptr. 38 (11): 794-795.
22. Young, T. W., and G. D. Ruehle, 1955. The role of the burrowing and meadow nematodes in avocado decline. U. S. Dept. Agric., Pl. Dis. Reptr. 39 (11): 815-817.

[3] Spears, Joseph F., 1956. Report of the burrowing nematode survey in California, February 23-May 1, 1956. U. S. Dept. Agric., Agric. Res. Serv., Plant Pest Control Branch, Golden Nematode Control Project, Hicksville, New York (mimeographed).

An Internal Symptom for Identifying Fanleaf in the Grapevine

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Fanleaf is a serious disease of the grapevine largely responsible for vineyard decline in many districts in California (4). Since its spread to new vineyards is mostly or entirely through the distribution of diseased rootstock and scion wood, methods of identifying diseased wood are important in control. Attention is called to this in a recent paper (6) which describes external deformities of dormant canes—e.g. short internodes, double nodes, and fasciations, which may serve in the identification of diseased vines.

This paper presents the results of a study[1] of an internal anatomical structure reported to be associated with the disease in Europe. The present studies were of diseased and normal wood in California grown grape varieties and rootstocks, and the results give strong evidence that this structure may serve in the identification of vines with fanleaf.

The structure is in the form of a beam or rod which extends across the cavity of a dead water-conducting cell of the xylem or wood (Fig. 1). This structure, first reported by Petri in 1912, is termed a trabecula (trabeculae, pl.) in accordance with modern terminology. In the literature these structures have frequently been called "cordoni endocellulari" (Italian), "cordons endovasculaires" or "cordons endocellulaires" (French), "intracellularen stäbe" (German), or "intracellular cordons" when anglicized. There may be more than one trabecula per water-conducting cell (or tracheary element). Tracheary elements are of two types: (1) a perforate cell at maturity—a vessel member, and (2) an imperforate cell—a tracheid. Trabeculae are generally described as occurring in vessel members, but their presence in tracheids should not be unexpected. They may occur in other cells of the xylem (Fig. 1C). In fact, they may be present in food-conducting cells of the phloem (part of the bark) forming connecting rows across the cambium into the xylem. In all cases the trabeculae are oriented radially when they occur in cells of the xylem and phloem. Their occurrence also has been reported by several investigators in living cells of the pith, cortex, and epidermis. (2, 7, 8, 9).

There is no agreement, however, as to whether there is a strict correlation between the presence of trabeculae and the disease. While all evidence points toward a correlation, it was considered important to test it rigorously and objectively in several varieties of grapes grown in California.

Materials and Methods

In earlier anatomical studies of the disease, counts of trabeculae were obtained from sections of canes (3, 9). In the present study, this rather painstaking and technical operation was replaced by employing reagents which dissolve the cementing substance between cells, whereby they become dissociated from one another. This process is termed maceration. The wood of diseased and healthy vines was macerated because the trabeculae in water-conducting cells of the wood are the most easily observed.

Wood samples to be macerated were taken from internodes after the bark and pith were removed. The xylem was cut into small pieces, roughly half the length

[1] Part of the work reported herein, and done by C. H. Lamoureux, was under Agricultural Marketing Service Project Number RM: C-3550-27, for which state funds were matched with federal funds received from the Agricultural Marketing Service, United States Department of Agriculture, under provisions of the Agricultural Marketing Act of 1946. The authors wish to express their appreciation particularly to Messrs. Gilbert L. Stout and H. Keith Wagnon of the California Department of Agriculture for their cooperation during the course of this work.

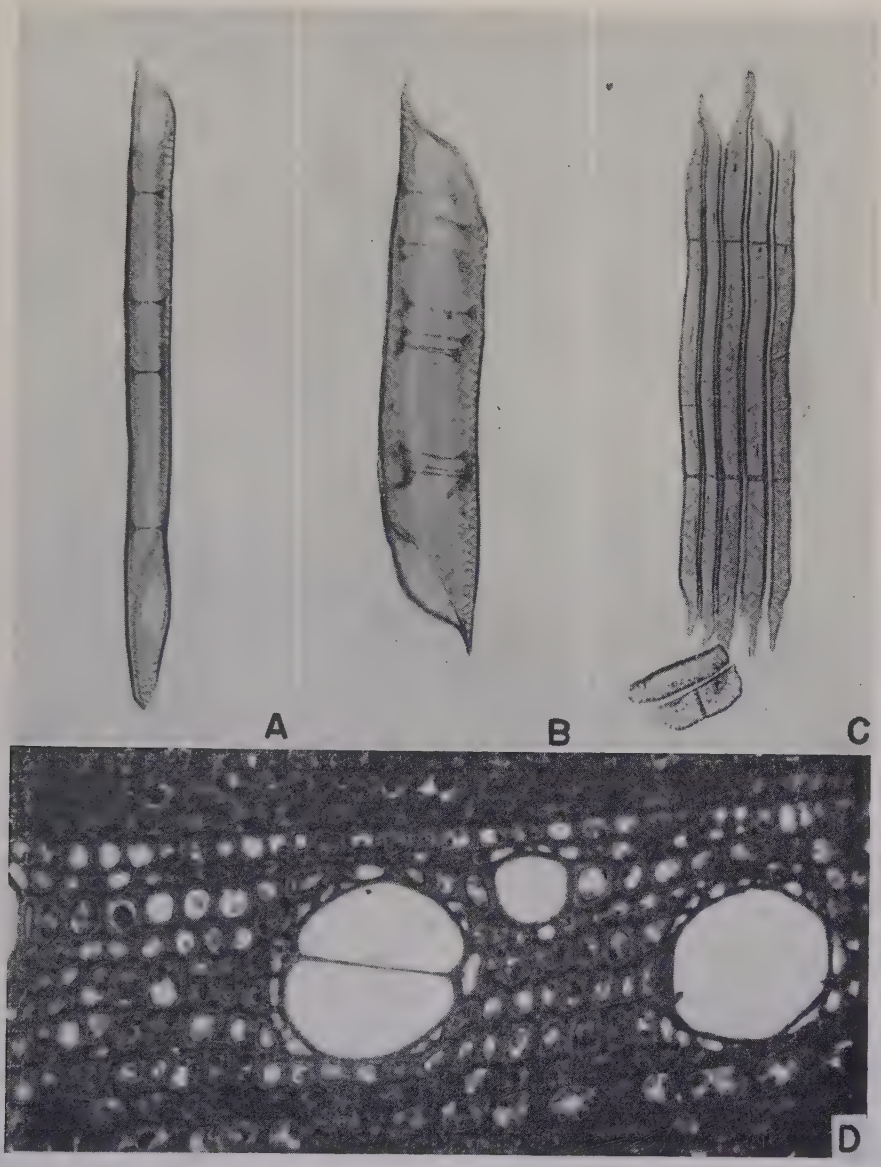

FIGURE 1. A, B and C—Photomicrographs of individual cells and a group of cells from macerated wood of grapevines having fanleaf. One vessel member with four trabeculae (A), one vessel member with approximately nine trabeculae (B), and a group of four fibers with two rows of trabeculae (C). All 185 X. D—Transverse section of wood from a diseased cane, showing one large vessel member with one trabecula (near center of illustration). 300 X.

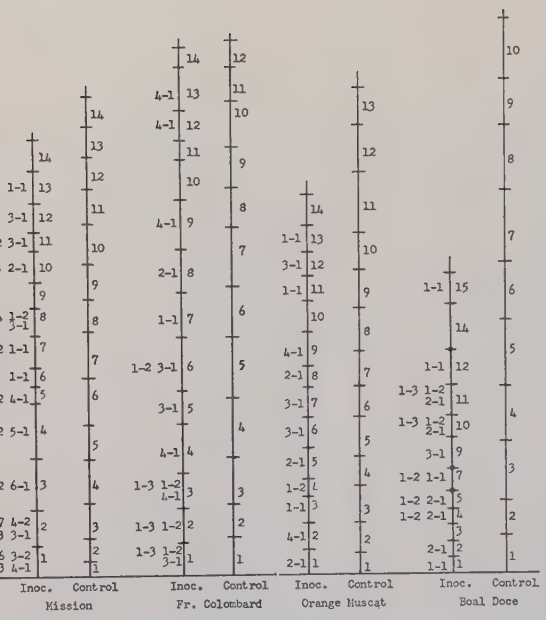

FIGURE 2. The frequency in occurrence of tracheary elements with trabeculae from the internodes of canes from four varieties of healthy (control) and inoculated vines. The number of elements with trabeculae and the number of trabeculae in each are indicated, viz. 1-2, one element with two trabeculae; 2-3, two elements with three trabeculae in each cell, etc. Cross lines represent nodes. Double nodes (probably extremely short internodes) are indicated in inoculated Boal Doce by large black dots. Scale: 0.1" = 1".

and diameter of small matchsticks. One-half-gram samples were prepared from each internode and placed in a vial with the following macerating fluid as described in a recent leaflet (1) published by the Forest Products Research Laboratory, England: 1 part superoxol (a 30 percent solution of H_2O_2), 4 parts distilled water, and 5 parts glacial acetic acid.

Approximately 10 ml. of the above fluid was found to be sufficient for each half-gram of xylem. The vials were corked tightly, and placed in a paraffin embedding oven at 56 degrees C. for about three days. At the end of this period, if the maceration was complete, the fluid was clear and colorless, and the segments of xylem were whitish and translucent. If the fluid was yellowish, and if the xylem was not translucent, the old fluid was poured off, fresh fluid added, and the vial replaced in the oven for an additional 24 to 48 hours.

When maceration was complete, the fluid was poured off, and the material washed three times in distilled water. After the third change of water was poured off, exactly 5 ml. of 0.5 percent safranin solution in 30 percent ethyl alcohol was added to each vial. A brisk shaking of the vial was then usually sufficient to separate the cells. If the cells did not separate on shaking, they could be teased apart with a pair of dissecting needles. The alcohol solution acted as a preservative as well as a stain, and the material could be kept indefinitely in the corked vials.

After agitating the vial and using a modified medicine dropper, an amount of fluid just sufficient to be covered by a 22 mm. x 22 mm. coverslip was placed on a clean slide, and a glass coverslip put in position. The proper amount of fluid was determined after a few attempts. The level on the medicine dropper was marked, and after a little practice samples of equal volumes were obtained. The entire area under the coverslip was examined systematically, using a compound microscope with a mechanical stage. Slide, coverslip, and dropper were cleaned by dipping them in concentrated HCl, and then in two changes of water. This method of cleaning seemed to eliminate the possibility of contamination between samples.

If samples could not be prepared immediately, selected portions of the canes were put into plastic bags and placed in a refrigerator. This action was taken to prevent drying out, thus insuring more uniformity of the samples, since they were prepared on a weight basis.

Some preliminary work was done to confirm the presence of trabeculae in plants definitely known to have fanleaf. After their occurrence was confirmed, canes were selected at random from healthy vines and diseased vines which had been graft-inoculated in 1952 in the virus disease isolation plots at the University of California, at Davis, California.

In January, 1955, one dormant cane was selected from each of healthy and inoculated vines of several varieties. Macerations were made from the xylem of each internode. Numbers of trabeculae for each internode were compiled from three samples. The length of each cane and the internode lengths were plotted to scale, and the number of elements with trabeculae was recorded. Not only the number of cells with trabeculae was recorded, but also the number of trabeculae in each instance. The re-

sults for four varieties are summarized in Figure 2. Some internodes near the ends of diseased canes revealed the presence of trabeculae, but are not shown in the figure. No trabeculae were found in canes from the control (healthy) vines. Trabeculae, however, were found in all canes taken from fanleaf vines. Although trabeculae were not found in samples taken from all internodes of canes from fanleaf vines, they were found in all samples of the basal eight internodes. In this series, the number of trabeculae ranged from one to as many as six per cell. Except for diseased Boal Doce the canes did not have double nodes, although internode length was more variable in diseased material, and the canes were considerably shorter than those from control vines.

In June, 1955, additional material was collected: (1) from healthy and inoculated vines from the same isolation plot at Davis; (2) from indexed rootstocks found to be free of known virus diseases (vines maintained at Davis); and (3) from diseased vines growing in Santa Clara County, California. For this study only basal internodes were examined, in most instances only the first four. The results are tabulated in Table 1. The total number of elements examined varies for each cane. This variance is due in part to the number of samples prepared, and in part to the method of sampling. In all instances, trabeculae were observed in tracheary elements from the wood of canes definitively known to be diseased, or from canes of vines inoculated with fanleaf. In one instance, in the variety Concord, a trabecula was found in the wood of control material. The possibility of sample contamination in this case is not eliminated. There is also the possibility that the vine became infected via the soil subsequent to planting, because there is supported evidence to indicate that the disease is soil transmitted (5). The very close proximity of vines (one foot apart in this plot) sustains this view. Also it should be pointed out that the vines of Concord which had been inoculated with fanleaf, did not exhibit the usual external symptoms associated with fanleaf although trabeculae were found in tracheary elements. Hence the "control" plant may have had an attenuated strain of the disease, even though it did not exhibit external symptoms.

A test case was made of a cane from a vine of the variety Cardinal which showed

TABLE I

Variety	External Symptoms	Number of Samples	Total no. elements counted	Elements with Trabeculae	Percent Elements with Trabeculae
		Davis Isolation Plot			
Muscat Alexander (inoculated)	fanleaf leaf mottling	12	1937	68	3.5
Muscat Alexander (control)	none	12	1330	none	
Talia (inoculated)	fanleaf leaf mottling	12	1979	65	3.3
Talia (control)	none	12	1910	none	
Concord (inoculated)	Dwarfing only (in 1955)	12	2447	33	1.3
Concord (control)	none	12	1357	1	.07
Salvador (inoculated)	fanleaf leaf mottling	12	2519	76	3.01
Cabernet Sauvignon (inoculated)	fanleaf	12	2824	49	1.8
Cardinal	questionable	9	2144	2	.09
		Davis indexed rootstock			
St. George (6 canes)	none	24	6687	none	
1613 (6 canes)	none	24	7277	none	
		Santa Clara County			
Salvador	mild	4	1080	3	0.28
Salvador	definite	4	1490	35	2.3
Salvador	severe	4	2056	79	3.8
Salvador	very severe	4	1564	113	7.2

TABLE 1. The number of tracheary elements having trabeculae from a selected group of canes of several varieties of the grapevine. Presence or absence of any external symptom of fanleaf is indicated in each instance. (See text for additional explanation.)

only "questionable" external symptoms. Only two cells in 2,144 examined showed trabeculae, but this information, correlated with suspected external symptoms, points convincingly toward fanleaf.

An intensive survey of indexed rootstock material (St. George and 1613) from the collections at Davis yielded no trabeculae.

A collection of four canes of the variety Salvador from Santa Clara County, selected for their varied expression of external symptoms, was processed, and the results tabulated. Fewer trabeculae occurred in tracheary cells of canes with mild or questionable external symptoms, while the cane from a vine with extreme or severe fanleaf symptoms showed the highest number of cells with trabeculae for any cane used in the study. This correlation still exists if the number of elements with trabeculae is computed on the basis of elements with trabeculae per thousand cells.

Conclusions

This study supports the belief that the presence of trabeculae can be used as an aid in the diagnosis of fanleaf disease in the grapevine, because with but one exception trabeculae were found only in wood elements of vines which had been inoculated with fanleaf, which were showing external symptoms of the disease.

In summary, if any of the tracheary elements of the xylem have trabeculae, the health of the vine should be questioned. The search for other internal criteria (morphological or physiological) should be extended.

Literature Cited

1. Anonymous, 1951. The preparation of wood for microscopic examination. Forest Products Research Laboratory, England. Leaflet No. 40.
2. Bode, H. R., 1937. Uber die Entwicklungsgeschichte der intracellulären stäbe im Cambium. Gartenbauwiss. 11:272-288.
3. Gallay, R., W. Wurgler, R. Bovey, M. Staehelin and H. Leyvraz, 1955. La dégénérescence infectieuse de la vigne. Rev. romande d' agr. de vit. et d' arbor. 11:17-24.
4. Hewitt, W. B., 1954. Some virus and virus-like diseases of grapevines. Calif. Dept. of Agric. Bul. 43:47-64.
5. Hewitt, W. B., 1956. Fanleaf virus of grapevines is soil borne. Phytopathology. 46:15 (Abs.).
6. Hewitt, W. B, and E. M. Gifford, Jr., 1956. Symptoms for identifying fanleaf in dormant grapevines. Calif. Dept. of Agric. Bul. 45:249-252.
7. Maier, W., 1939. Die Häufigkeit der Zellstäbe in den Internodien der Triebe reisigkranker Reben. Wein und Rebe. 21:240-250.
8. Petri, L., 1913. Les abaissements de température et le Court-noué de la vigne. Rev. Phyto. app. 1:33-36; 57-58.
9. Schneiders, E., 1937. Uber die zellstäbe und ihre phytopathologische Bedeutung. Gartenbauwiss. 11:237-250.

Results of Inspections of Grapevine Cutting And Scion Source Plantings for Virus And Viruslike Disorders, 1956 [1]

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Plant propagators in 1956 designated 98 properties in 13 California counties as grapevine cutting, scion and rootstock source plantings. These plantings were inspected to determine if the vines were carrying any disorders that could be transmitted or perpetuated in the scions or cuttings. A total of 413,226 vines were inspected on approximately 850 acres. The diseases or disorders for which inspections were made, the number of vines that showed definite symptoms (positive), and the number of vines that did not show definite symptoms but showed symptoms suggestive of each disease or disorder (suspect) are listed in the following table:

	Number of vines	
	Positive	*Suspect*
Diseases		
Yellow vein virus disease	1,773	106
Yellow mosaic virus disease	2	6
Fanleaf virus disease	504	134
Pierce's virus disease	3	2
White emperor virus disease	680	--
Other Disorders		
Genetic	59	--
Unproductive vines	58	--
Weak vines	63	--
Viruslike	10	--
Off-variety	1,547	--
Total vines unfit for propagative purposes	4,699	246

[1] Observations reported in this article were obtained during work done under Agricultural Marketing Service Project No. RM: C-3550-27, for which state funds were matched with federal funds received from the Agricultural Marketing Service, United States Department of Agriculture, under provisions of the Agricultural Marketing Act of 1946.

California Farm Production and Value

COMPILED BY CALIFORNIA CROP AND LIVESTOCK REPORTING SERVICE

ESTIMATED CASH FARM RECEIPTS FROM FARM MARKETINGS, CALIFORNIA 1953, 1954 AND 1955

	From crops	*From livestock, poultry, and products*	*Total*
1953	$1,662,660,000	$971,250,000	$2,633,910,000
1954	1,613,574,000	904,810,000	2,518,384,000
1955	1,681,277,000	951,373,000	2,632,650,000

ESTIMATES OF THE PRODUCTION AND FARM VALUE OF PRINCIPAL PRODUCTS OF CALIFORNIA FARMS IN 1955 [1]

Commodity	*Acreage*	*Production*	*Farm value*
Dairy products		6,937,000,000 lbs. (sold)	$313,035,000
Cattle and calves		1,687,615,000 lbs. (sold)	303,051,000
Cotton lint	745,000	1,210,121 bales (500# gross)	
Cotton seed		495,000 tons	223,467,000
Hay	1,973,000	6,652,000 tons	169,626,000
Eggs (chicken)		4,300,000,000 no. (sold)	149,425,000
Grapes	423,774	3,016,000 tons	116,420,000
Lettuce	125,100	26,294,000 crates (70#)	86,317,000
Tomatoes	151,900	2,249,468 tons	86,000,000
Oranges	183,208	39,420,000 boxes (77#)	82,981,000
Barley	1,838,000	68,925,000 bu. (48#)	71,682,000
Peaches	75,625	816,000 tons	62,194,000
Potatoes	115,600	29,189,000 cwt.	56,919,000
Chickens (all)		223,016,000 lbs. (sold)	55,105,000
Turkeys		10,120,000 head (sold)	54,794,000
Rice	329,000	11,186,000 cwt.	50,337,000
Walnuts	114,215	70,000 tons	38,080,000
Lemons	52,931	14,000,000 boxes (79#)	38,080,000
Sugar beets	162,600	3,365,000 tons	37,015,000
Prunes	89,544	131,000 tons dry	36,549,000
Strawberries	14,000	17,640,000 trays (12 pt)	33,698,000
Beans (dry)	323,000	4,109,000 cwt.	33,694,000
Almonds	89,391	38,300 tons	32,976,000
Celery	15,400	13,543,000 crates (60#)	31,931,000
Apricots	38,736	253,000 tons	26,565,000
Sheep and lambs		144,107,000 lbs. (sold)	25,882,000
Corn (field)	245,000	16,170,000 bu. (56#)	25,872,000
Pears	38,806	347,000 tons	25,855,000
Asparagus	76,700	96,310 tons	25,448,000
Carrots	23,000	7,828,000 crates (75#)	24,917,000
Alfalfa seed	178,000	85,440,000 lbs.	19,651,000
Cantaloups	44,300	6,354,000 crates (83#)	19,584,000
Wheat	423,000	8,883,000 bu. (60#)	18,388,000
Hogs		103,788,000 lbs. (sold)	18,168,000
Grain Sorghums	182,000	9,700,000 bu.	11,349,000

ESTIMATES OF THE PRODUCTION AND FARM VALUE OF PRINCIPAL PRODUCTS OF CALIFORNIA FARMS IN 1955[1]—Continued

Commodity	*Acreage*	*Production*	*Farm value*
Plums	21,094	86,000 tons	11,340,000
Broccoli	24,200	3,220,000 crates (42#)	10,888,000
Apples, com'l only	22,059	9,440,000 bu. (44#)	10,856,000
Beans, snap	10,400	57,400 tons	9,677,000
Avocados	16,292	45,200 tons	9,447,000
Cherries	9,342	34,000 tons	9,078,000
Olives	28,743	39,000 tons	8,775,000
Wool		15,666,000 lbs.	7,676,000
Potatoes, sweet	13,000	923,000 cwt.	6,969,000
Cauliflower	11,800	5,380,000 crates (37#)	6,725,000
Figs, all	24,337	88,200 tons	6,580,000
Onions	9,400	5,572,000 sacks (50#)	6,448,000
Flaxseed	60,000	1,740,000 bu. (56#)	5,812,000
Corn (sweet)	21,900	3,671,000 crates (50#)	5,692,000
Honeydew melons	9,200	2,756,000 crates (44#)	5,387,000
Watermelons	17,700	125,810 tons	5,301,000
Beans, green lima	23,500	34,660 tons	5,220,000
Oats	176,000	5,632,000 bu. (32#)	4,618,000
Cabbage	8,200	91,700 tons	4,594,000
Grapefruit	8,219	2,420,000 boxes (62#)	4,379,000
Honey and beeswax		30,072,000 lbs. honey	4,343,000
Peppers, bell	3,300	1,650,000 bu. (25#)	3,630,000
Hops	5,200	8,112,000 lbs.	3,569,000
Nectarines	3,029	23,800 tons	3,552,000
Cucumbers	6,200	51,410 tons	3,492,000
Peas, green	16,100	26,625 tons	3,327,000
Artichokes	8,900	890,000 boxes (40#)	3,026,000
Brussel sprouts	4,300	17,200 tons	2,872,000
Dates	4,598	24,000 tons	2,673,000
Spinach	11,500	77,080 tons	2,594,000
Garlic	2,600	195,000 cwt.	2,086,000
Sudan grass seed	30,000	40,500,000 lbs.	1,984,000
Ladino clover seed	15,000	3,450,000 lbs.	1,846,000
Peppers, chili	2,800	3,780 tons	1,686,000
Persian melons	2,300	230,000 crates (83#)	966,000
Vetch seed	20,400	5,620,000 lbs.	502,000
Peas, dry field	6,000	73,000 cwt.	496,000
Persimmons	576	2,400 tons	310,000
Alsike clover seed	2,400	1,020,000 lbs.	209,000
Mustard seed	1,000	1,200,000 lbs.	144,000
Mohair		27,000 lbs.	16,000

[1] Brief explanatory notes about the data in the accompanying table:

Some of the estimates of crop values and cash receipts are subject to minor revisions when more nearly complete data on production and prices become available.

Besides the commodities listed, there are many relatively minor crops grown and a number of livestock and poultry commodities produced in the State for which official estimates are not made. Therefore, these data do not record total production nor total value of *all* farm commodities.

The figures for crops listed include quantities and values of the portions of those crops fed to livestock and poultry on farms where grown, and thus relate to the entire crop in each case, whether or not sold or fed in the year produced. The value figures for livestock, poultry and their products represent the cash receipts by producers from the sales of same during the calendar year 1955. Thus, a combined total of the values listed in the table would include some duplication between the values of crops grown and the receipts from the sales of livestock, poultry and their products.

A more acceptable measure of the over-all annual value of the State's farm production is shown by the department's estimates of the cash receipts from producers' sales of farm products during the calendar year. In these are included estimates for minor commodities. These estimates for 1953, 1954, and 1955 are shown on Page 273. During the 26-year period 1930 to 1955, inclusive, cash receipts from farm marketings by California farmers have exceeded those from any other state, except for the years 1940, 1941, 1942, 1947 and 1949 when California ranked second to Iowa in this respect.

Sacramento, California, September 26, 1956.

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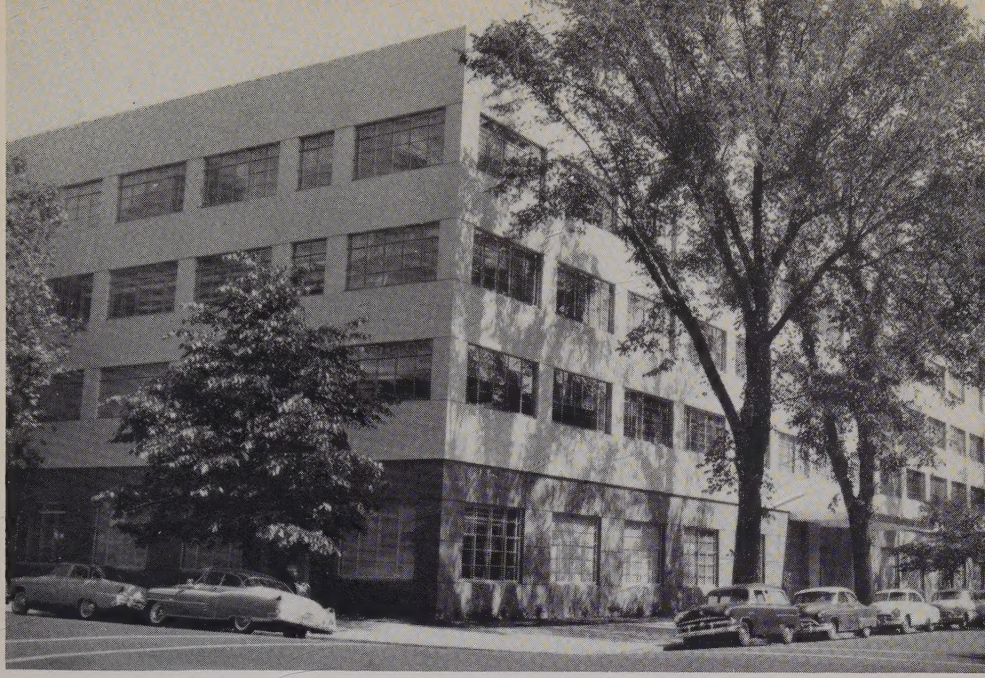

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